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SOME LITTORAL BARNACLES FROM THE TUAMOTU, MARSHALL, AND CAROLINE ISLANDS[1]

By Dora Priaulx Henry

A small number of barnacles collected by the Pacific Science Board expeditions at three localities—Ngarumaoa Island, Tuamotu Islands; South Loi Island, Marshall Islands; and Ifaluk Atoll, Caroline Islands—was sent to the author for identification. In all, there are seven species: three from the Caroline Islands, one from the Marshall Islands, and four, including one new species, from the Tuamotu Islands. In addition, a few barnacles collected by the *Albatross* at Makemo, Tuamotu Islands, were borrowed from the U. S. National Museum (USNM) to compare with the new material. Although the collection is small, it is of considerable interest as nothing is known of the barnacles of these islands except for *Lithotrya nicobarica* Reinhardt, which was reported from Makemo as *Lithotrya pacifica* Borradaile by Pilsbry (1907). The collection from Ngarumaoa Island contains *Lithotrya nicobarica* Reinhardt, *Lithotrya valentiana* (Gray), *Verruca cookei* Pilsbry, previously known from the Hawaiian Islands, and a new species of *Chthamalus*, which is of special interest as it is the first member of the genus to possess a true calcareous basis. A few small specimens of this species were also found on *Lithotrya nicobarica* from

[1] Contribution No. 210 from the Department of Oceanography, University of Washington, Seattle, Wash.

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Makemo. The one species from the Marshall Islands is *Tetraclita pacifica* Pilsbry, originally described by Pilsbry (1928) as *Tetraclita wireni pacifica* from Necker and Wake Islands. The barnacles from the Carolines are *Chthamalus hembeli* (Conrad), *Tetraclita squamosa squamosa* (Bruguière), and *Lithrotrya nicobarica* Reinhardt.

Genus *Lithotrya* Sowerby, 1822 [2]

Sewell (1926), after a detailed study of a large number of specimens of *Lithotrya nicobarica*, lists all the known species and subspecies of *Lithotrya* except *L. dorsalis*, *L. truncata*, *L. valentiana*, and *L. rhodiopus* as synonyms of *L. nicobarica* Reinhardt. However, at the end of his paper, he states that it is his belief that *L. dorsalis* and *L. nicobarica* cannot be differentiated. Nilsson-Cantell (1933) compared *L. dorsalis* from Bonaire and various museums with *L. nicobarica* from several localities, and he believes that these two species are distinct. Cannon (1935) has shown that *L. truncata* is a synonym of *L. valentiana*. *L. rhodiopus* is known only from Darwin's (1851) description of imperfect specimens so that its position is still doubtful. The valid species in the genus *Lithotrya* are, therefore, *L. dorsalis*, *L. nicobarica*, *L. valentiana*, and possibly *L. rhodiopus*.

Lithotrya nicobarica Reinhardt

Lithotrya nicobarica Reinhardt, 1850, p. 1, pl. 1, figs. 1–3.—Darwin, 1851, p. 359, pl. 8, fig. 2.—Gruvel, 1905, p. 99.—Hoek, 1907, p. 122, pl. 9, fig. 9.—Annandale, 1916, p. 131, pl. 7, fig. 2.—Nilsson-Cantell, 1921, p. 219; 1934a, p. 45.—Sewell, 1926, pp. 269–300, 18 figs., pls. 14, 15.—Hiro, 1937, p. 44.

Lithotrya cauta Darwin, 1851, p. 356, pl. 8, fig. 3.

Lithotrya pacifica Borradaile, 1900, p. 798, pl. 51, figs. 3, 3a.—Hoek, 1907, p. 126, pl. 9, figs. 13, 13a, 14.—Pilsbry, 1907, p. 6.

Lithotrya dorsalis var. *maldivensis* Borradaile, 1903, p. 441.

Lithotrya dorsalis var. *rugata* Borradaile, 1903, p. 441.

Lithotrya conica Hoek, 1907, p. 124, pl. 9, figs. 10–12.

Localities.—Ngarumaoa Island, Raroia Atoll, Tuamotu Islands; collected by J. P. E. Morrison, July 11, 1952, on outer reef flats, with *Chthamalus calcareobasis* and *Verruca cookei* (11 specimens, USNM 96480).

Makemo, Tuamotu Islands; collected by the *Albatross*, Oct. 21 1899, on the reef, with *Chthamalus calcareobasis* (7 specimens, USNM, 32885).

South end of Falarik Island, Ifaluk Atoll, Caroline Islands; collected by F. M. Bayer, Oct. 22, 1953, dug out of large rock just inside high reef (2 specimens, USNM 99341).

[2] For synonymy, see Darwin (1851, p. 332).

Remarks: Several of the specimens are larger than the largest (greatest carinorostral diameter of the capitulum, 11.5 mm.) examined by Sewell (1926). The specimens from Ngarumaoa Island vary in carinorostral diameter from 6 mm. to 16 mm.; those from Makemo, from 11 mm. to 18 mm.; and the two from the Ifaluk Atoll, from 15 mm. to 16 mm. Externally, the specimens show most of the variations figured by Sewell. The cirri and mouthparts of a specimen with a carinorostral diameter of 18 mm. from Makemo are of special interest as the specimen was in the last stage before molting. The new long spines of the cirri are situated close to each ramus with their ends pointed distally and not "with their upper ends enclosed within the old spines, but with their lower ends projecting inwards, beyond the bases of the old spines, and inverted like the fingers of a glove hastily pulled off" as stated by Darwin (1854, p. 157). The labrum has 60 teeth. Sewell found 40 teeth on a small specimen and 42 on one of the largest, so he concluded that there is little change in the number of teeth with advancing age. The palps have rounded ends with doubly serrate spines on the ends and upper margins. In one mandible, between the first and second tooth, the new edge has 25 pectinations and the old edge has 13, some of which are broken off; between the second and third tooth the new edge has 9 pectinations and the old edge has 3. The other mandible has 19 pectinations on the new edge and 12 on the old edge between the first and second tooth, and 10 on the new edge and 8 on the old edge between the second and third tooth. There is also a greater number of pectinations on the new edge of the inferior angle than on the old edge. Sewell has pointed out that the ratio of the number of pectinations between the first and second tooth to the number between the second and third tooth is not a valid diagnostic character as the rate changes with advancing age. The number of spines in the middle group on the inner maxilla is also greater (17 instead of 10) in this specimen than in Sewell's largest specimen, although the number above the notch, in the notch, and on the inferior angle is the same. The outer maxilla has a slight notch without spines. One caudal appendage has 19 segments, the other has 11 segments. In a specimen with a carinorostral diameter of 16 mm., one caudal appendage has 27 segments and the other has 20 segments. Both specimens have five pairs of spines and seven or eight small spines between the pairs on the median segments of the sixth cirrus. Sewell found four pairs of spines and six or seven small spines in the largest specimen.

Lithotrya valentiana (Gray)

Conchotrya valentiana Gray, 1825, p. 102.
Anatifa truncata Quoy and Gaimard, 1834, p. 636, pl. 93, figs. 12–15.

Lithotrya valentiana Darwin, 1851, p. 371, pl. 8, fig. 5.—Gruvel, 1902, p. 250.—Barnard, 1924, p. 48.—Cannon, 1935, pp. 1–17, 7 figs., 2 pls.—Hiro, 1937, p. 42, 1 fig.

Lithotrya truncata Darwin, 1851, p. 366, pl. 9, fig. 1.—Hoek, 1907, p. 127.—Nilsson-Cantell, 1921, p. 213, fig. 34.

Lithotrya truncata longicaudata Nilsson-Cantell, 1921, p. 216, fig. 35a.

LOCALITY: Ngarumaoa Island, Raroia Atoll, Tuamotu Islands; collected by J. P. E. Morrison, July 8, 1952 (1 specimen, USNM 96481).

REMARKS: Greatest diameter of capitulum, 5.5 mm., greatest height, 6.5 mm. Laterals wanting; one membranous filament on one side and two on the other side.

Genus *Verruca* Schumacher, 1817 [3]

Verruca cookei Pilsbry

PLATE 1, FIGURES *a–j*

Verruca cookei Pilsbry, 1928, p. 308, 2 figs., pl. 25, fig. 9.

LOCALITY: Ngarumaoa Island, Raroia Atoll, Tuamotu Islands; collected by J. P. E. Morrison, July 11, 1952, on outer reef flats; on *Lithotrya nicobarica;* with *Chthamalus calcareobasis* (2 specimens).

REMARKS: The specimens, one about 1.8 mm. in carinorostral diameter, the other 2.2 mm., were situated between two growth ridges on the scutum of *Lithotrya nicobarica* with the long (carinorostral) axis parallel to the base of the scutum. These specimens differ somewhat from the typical form. Both have the right-hand, instead of the left-hand, scutum and tergum fixed, and both are elongate in the carinorostral axis, instead of subcircular (pl. 1,*a*,*b*). In the larger specimen, the upper articular ridge of the movable scutum is about a third of the tergal margin, the second articular ridge is a little over two-thirds the tergal margin, and the third ridge extends to the base (pl. 1,*c*). Internally, the upper part of the valve is hollowed out, the tergal margin is slightly inflected in the upper part, and the occludent margin is strongly inflected (pl. 1,*b*). The movable tergum is triangular in shape instead of quadrangular as in the type; the third articular ridge is low in the upper part (pl. 1,*e*). Internally, the occludent margin is inflected (pl. 1,*d*). In the fixed scutum (pl. 1,*f*), the adductor ridge, which is narrower than in the type, extends obliquely from the base of the narrow rostral margin to the inner part of the thick tergal margin. The straight plate of the fixed tergum (pl. 1,*g*) is higher than the adductor ridge of the scutum. The rostrum (pl. 1,*i*,*j*) has three teeth on the carinal margin and seven fine ridges on the

[3] For synonymy, see Pilsbry (1916, p. 15).

upper part of the scutal margin. Plate 1,*i* also shows a crack extending from the apex of the plate to the basal margin, and a heavy deposit of calcareous material covering the crack can be seen on the inner side (pl. 1,*j*). The carina (pl. 1,*h*) has three teeth on the rostral margin and several fine ridges on the upper part of the tergal margin. In the smaller specimen, a narrow projection of the carinal margin of the rostrum fits into a furrow on a slightly broader projection of the rostral margin of the carina; the adductor ridge of the fixed scutum is very prominent.

The mouthparts and cirri agree, for the most part, with Pilsbry's description. The larger specimen, which contained eggs, has 10 segments in the caudal appendages and 5 pairs of spines on the posterior cirri. The smaller specimen has 6 segments in the caudal appendages and 5 pairs of spines on one or two segments of the sixth cirrus and 4 pairs on the rest.

Genus *Chthamalus* Ranzani

Chthamalus Pilsbry, 1916, p. 293 (synonymy).

DIAGNOSIS: Compartments six; rostrum and carina with alae; rostrolaterals triangular, without alae, the sheath having a narrow projection. Carinolaterals wanting. Basis membranous or calcareous; sometimes membranous basis covered with a calcareous layer formed of the inflected basal edges of the compartments.

Labrum with concave or straight edge, toothed or spinose. Mandible with lower part pectinated. First two pairs of cirri short, densely spinose, the third pair much longer and bearing spines like those of the posterior cirri.

TYPE: *Chthamalus stellatus* (Poli).

Chthamalus hembeli (Conrad)

Euraphia hembeli Conrad, 1837, p. 261, pl. 20, fig. 13.
Chthamalus hembeli Darwin, 1854, p. 465, pl. 18, figs. 5a–5e.—Weltner, 1897, p. 272.—Gruvel, 1905, p. 205.—Pilsbry, 1916, p. 324, pl. 76; 1928, p. 310, pl. 26, fig. 6.—Nilsson-Cantell, 1921, p. 290, fig. 55.

LOCALITY: Reef north of northwest end of Falarik Islet, Ifaluk Atoll, Caroline Islands; collected by D. P. Abbott, 1953, from big rock on outer reef flat 125 ft. in from breaker line (1 specimen, USNM 99340).

REMARKS: The external surface is corroded, more or less covered with worm tubes, and the orifice is worn down. Only one suture, which shows interlocking teeth, is discernible on the exterior, but all sutures are visible on the inside. The basis is completely covered by a nonstriate calcareous layer which is continuous with the inner

lamina of the parietes. The opercular valves agree with those figured by Pilsbry (1916, pl. 76, fig. 2c) except that the articular ridge of the scutum is not as prominent.

The carinorostral diameter is 50 mm.; the height of the rostrum is 15 mm. and height of the carina, 21 mm.

The cirri and mouthparts agree with the descriptions of Pilsbry (1916) except for the labrum, which has both spines and teeth as found by Nilsson-Cantell (1921) and one mandible with 2 strong teeth and a slight thickening instead of 3 strong teeth. The dentation of the mandible is apparently variable in this species as Nilsson-Cantell (1921) figures one mandible with a small tooth between the second and third teeth.

***Chthamalus calcareobasis*, new species**

PLATES 1,*k–n*; 2,*a–o*

TYPE SPECIMENS: Holotype, USNM 96482; paratypes, USNM 96483.

LOCALITIES: Ngarumaoa Island, Raroia Atoll, Tuamotu Islands; collected by J. P. E. Morrison, July 8, 1952, on *Tridacna maxima* on outer reef flat (3 specimens, USNM 96484); July 9, 1952, on coral patches near or on outer reef (*Lithothamnion*) ridge (about 50 specimens, USNM 96482, 96483, 96485); July 11, 1952, on outer reef flats; on *Lithotrya nicobarica*; with *Verruca cookei* (7 specimens, USNM 96480).

Makemo, Tuamotu Islands, collected by the *Albatross* Oct. 21, 1899, on the reef; on *Lithotrya nicobarica* (6 specimens, USNM 32885).

DIAGNOSIS: Distinguished from all other species of *Chthamalus* by the calcareous basis.

DESCRIPTION: Shell (pl. 2,*a*) shortly cylindric, sometimes with one or more compartments spreading, with quadrangular orifice; wall rugose or ribbed, moderately thick; epidermis not persistent. Color white or white tinged with pink or purple. Radii narrow, longitudinally striated as is the adjacent part of the adjoining compartment, summits oblique. Alae moderately wide, summits oblique. Sutures simple; disarticulated radii and alae show prominent interlocking denticles on the edges. Sheath purple or tinged with purple; inner lamina immediately below sheath purple, rest white. Basal margin of parietes (pl. 2,*b*) with several rows of teeth in shortly cylindric specimens; in spreading compartments, basal margin finely denticulate and inner lamina ridged. Basis (pl. 2,*c–f*) calcareous throughout, edge with pits or ridges (pl. 2,*c–d*), into which the denticles or ridges of the basal part of the parietes fit; flat (pl. 2,*e*) or, more usually,

irregularly elongate (pl. 2,*d*) or cupshaped (pl. 2,*f*); the depth of deepened bases may be greater than the height of the walls. Basis calcareous but thin in young specimens (carinorostral diameter about 5 mm.).

Carinorostral diameter, 24 mm.; height carina, 16 mm., rostrum, 14 mm. Carinorostral diameter, 12 mm.; height carina, 6 mm., rostrum 3 mm.; depth basis, 6 mm. Carinorostral diameter 5 mm.; height, 2.5 mm.

Opercular valves (pl. 2,*g–o*) not cemented together, lined with purplish black membrane. Scutum with basal margin about same length as tergal and shorter than occludent margin. Externally, white or white with purple splotches near tergal margin, moderate growth ridges, and, in young or noncorroded specimens, 1 to 3 shallow radial furrows, middle furrow usually deeper, may indent edge (pl. 2,*l–n*). Internally, color varying from white with purple splotches to purple with narrow white bands on the margins; tergal margin bisinuate with slightly reflexed articular ridge in the middle; adductor ridge wanting; adductor pit moderate; valve above pit usually roughened; pit with crests for lateral depressor muscle prominent; 3–4 crests for rostral depressor muscle close to occludent basal margin; occludent margin thick, alternate growth ridges forming somewhat oblique teeth on inner side.

Tergum with convex carinal margin thinner than rest of valve and a short wide spur (pl. 2,*g*,*i*,*o*). Spur united to the basiscutal margin and occupying about one-half the basal margin; longitudinal furrow wide and shallow. Externally, white or white with splotches of purple; growth ridges fine in main part of valve, wider in the spur furrow, usually obliterated on the thin carinal portion of the valve; fine longitudinal lines crenulate growth ridges in middle of valve; scutal margin inflected on the spur; crests prominent, projecting below basal margin, not denticulate. Internally, white with purple at apex and extending down the middle of valve; scutal margin with wide articular furrow below articular ridge, narrower above; articular ridge short and narrow, slightly reflexed in young and noncorroded specimens; middle part of valve roughened.

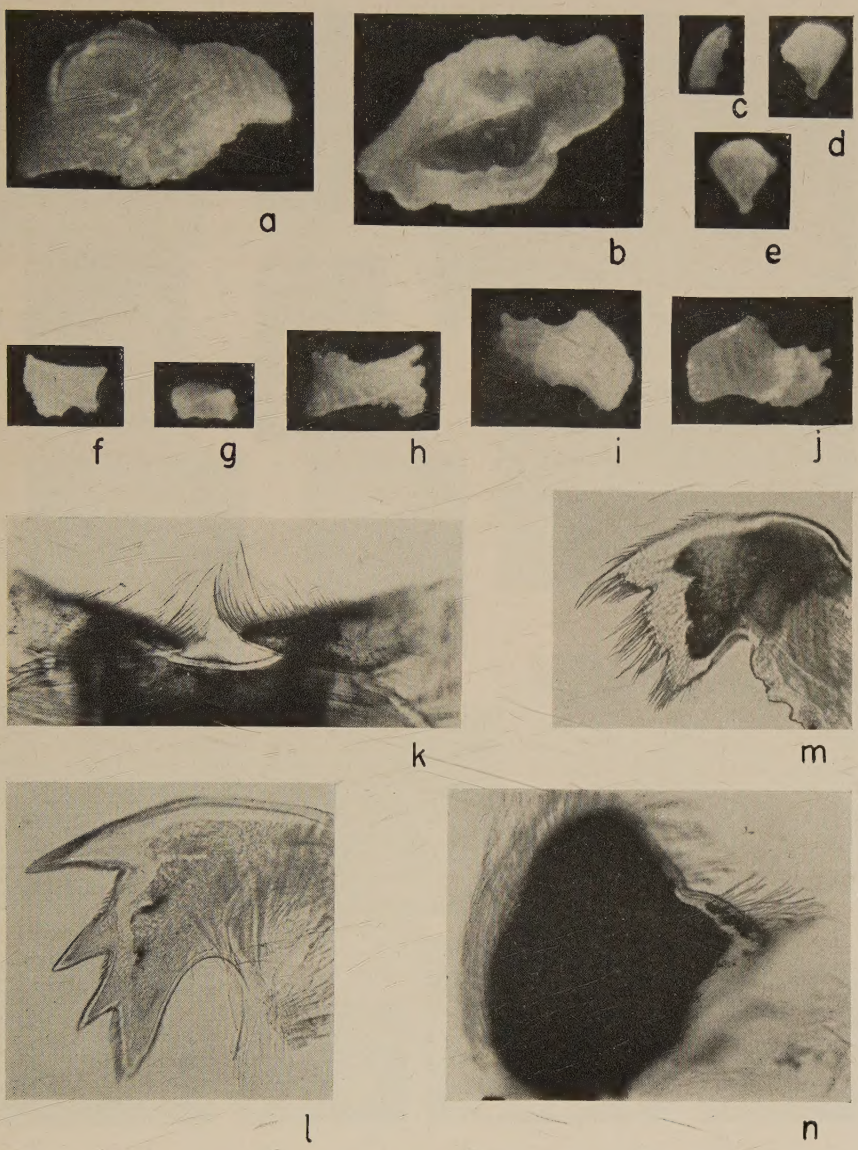
Labrum (pl. 1,*k*) with low teeth and spines along entire concave margin. Palp (pl. 1,*k*) with rounded end and pectinated spines, decreasing in size proximally, on the upper margin. Mandible (pl. 1,*l*) with three strong teeth and a lower pectinated point; pectinations between teeth; upper and lower margins spinose. First maxilla (fig. 1,*m*) with 1 large pair of spines and 7 or 8 small spines above upper notch, 7 or 8 pairs intermediate-sized spines on middle of valve, followed by a second notch and about 10 pairs of finer spines set on a

protuberance; upper and lower margins spinose. Second maxilla (pl. 1,*n*) with notch; spines absent in notch, elsewhere pectinated.

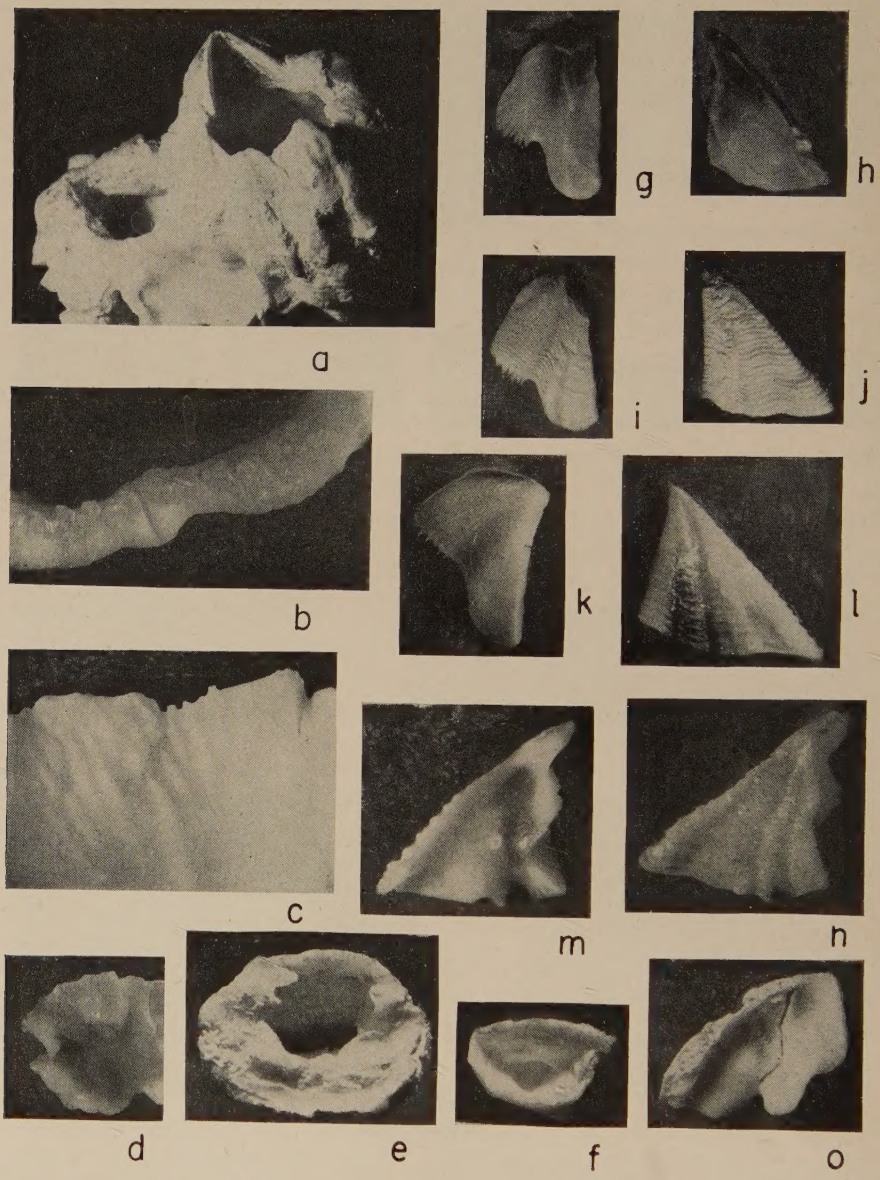
Cirrus I with 9 segments in anterior ramus, 7 in posterior; anterior, 2 segments longer than posterior; long spines pectinate on both rami, plumose on pedicel. Anterior ramus with short thick spines on the anterior and posterior borders of the basal 5 segments and similar but shorter spines on the distal sutures of all segments. Cirrus II with subequal rami of 7 and 9 segments; both rami with long pectinate spines and fine, multifid spinules on the distal sutures; anterior ramus with a few short thick spines on the posterior distal angles of the basal 3 segments. Cirrus III with subequal rami of 14 and 17 segments with 3 pairs of spines on the anterior borders and multifid spinules on the distal sutures. Posterior cirri with 3 pairs of spines and a small spine between each pair on the anterior borders, one or two long spines and several short thicker ones on the posterior distal angles, and multifid spinules on the distal sutures. Rami of cirrus IV with 18 and 19 segments, cirrus V, 20 and 17 segments, and cirrus VI, 20 and 19 segments. Penis with 2 tufts of terminal spines and a few fine spines scattered on the segments.

DISCUSSION: This species is very closely allied to *Chthamalus hembeli* (Conrad) as shown especially by the similarity of the scuta, the sutures, and the mandible. The main difference between the two species is the presence of a true calcareous basis in *C. calcareobasis*. Darwin (1854) examined five old specimens and three separated valves of a young specimen of *C. hembeli*. The old specimens had flat, wide, calcareous bases which were continuous with the inner laminae of the parietes, but in the young specimen (basal diameter about 18 mm.) he states: "there was no appearance of any tendency in the parietes thus to grow inflected." He believed that in a series of specimens some would be found with a flat narrow ledge as in *C. intertextus* and some with increasingly wider ledges until the edges met in the middle and coalesced into a continuous plate.

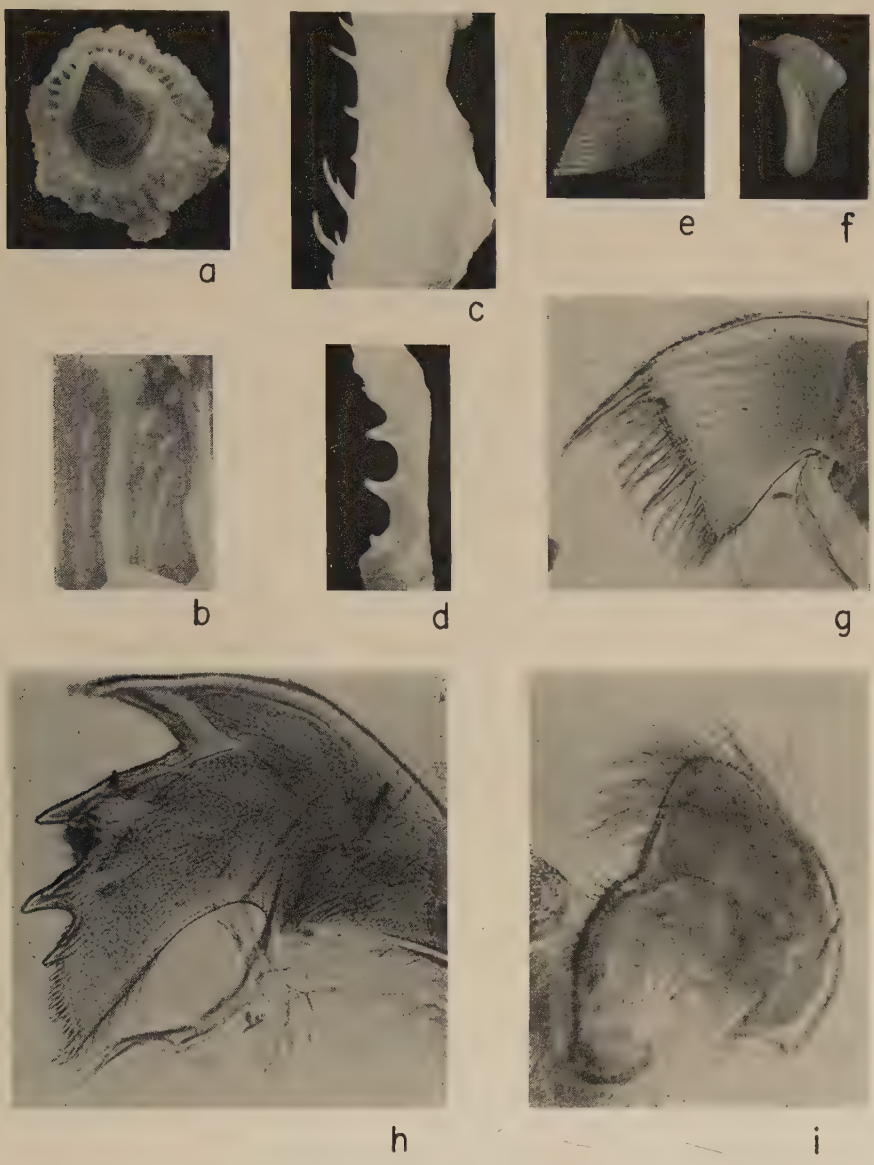
Pilsbry (1916) examined two large specimens and three opercular valves and the body of another specimen. He describes the basis as follows: " 'Basis membranous, but surrounded by a ledge formed by the inflected basal edges of the parietes,' or in old individuals the inflected edges of the compartments cover the whole base with a strong whitish calcareous layer. The false basis does not, of course, show radial furrows or lines, but is quite smooth." Pilsbry does not identify the source of his quotation, which is undoubtedly from Darwin (1854), but for another barnacle. Darwin (1854, p. 467) in the diagnosis of *C. intertextus* states: "basis membranous, but surrounded by a ledge formed by the inflected basal edges of the parietes." As seen in the paragraph above, Darwin believed that *C. hembeli* goes



a–j, *Verruca cookei* Pilsbry, × 20. *a*, Apical view; *b*, basal view, same specimen; *c*, *d*, internal views of movable scutum and tergum; *e*, external view of movable tergum; *f*, *g*, internal views of fixed scutum and tergum; *h*, external view of carina; *i*,*j*, external and internal views of rostrum. *k–n*, *Chthamalus calcareobasis*, new species, × 62. *k*, Labrum and palpi; *l*, mandible; *m*, first maxilla; *n*, second maxilla. All photographs by Eugene E. Collias.



Chthamalus calcareobasis, new species. *a*, Apical view of holotype (specimen on right side), × 2; *b*, basal view of rostrum and rostrolateral, × 10; *c*, internal view of edge of basis (shown in *d*), × 10; *d*, internal view of basis, × 2; *e*, basal view, showing part of basis, × 3; *f*, internal view of cup-shaped basis, × 2; *g–j*, internal and external views of opercular plates of holotype, × 3; *k*, *l*, external views of tergum and scutum of a young specimen, × 10; *m–n*, internal and external views of scuta of another young specimen, × 10; *o*, internal view of scutum and tergum, × 3.



Tetraclita pacifica Pilsbry. *a*, Basal view, × 2; *b*, internal view of outer lamina, × 10; *c*, lateral view of spines, × 7; *d*, longitudinal section of outer lamina, × 20; *e*, *f*, external views of scutum and tergum, × 3; *g*, first maxilla, × 62; *h*, mandible, × 62; *i*, second maxilla, × 62.

through this stage before the continuous plate found in old individuals is formed, but so far no one has seen the earlier stages in the formation of the basis. Nilsson-Cantell (1921) examined 3 specimens, one of which was only 25 mm. in diameter, but he does not mention whether this specimen had a continuous basis or not.

Another striking difference between *C. calcareobasis* and *C. hembeli* is the prominent spur on the tergum of *C. calcareobasis;* in fact, the spur is much more prominent than is usual for the genus. Further differences are found in the maxillae, palpi, and the cirri. In *C. calcareobasis* the spines of the first maxilla are differentiated by size into 3 groups and the notches are prominent, whereas, in *C. hembeli*, the spines, which are very numerous, vary much less in size and the notches are insignificant. The second maxilla of *C. calcareobasis* has a small notch without spines, but in *C. hembeli* there is no notch. The rami of the second cirrus of *C. calcareobasis* are subequal instead of very unequal as found for *C. hembeli* by both Pilsbry (1916) and Nilsson-Cantell (1921), and the sixth cirrus has 3 pairs of spines instead of 4 and does not have the bunches of short spines between the paired spines as found in *C. hembeli.*

Genus *Tetraclita* Schumacher

Tetraclita Pilsbry, 1916, p. 248 (synonymy).

Tetraclita squamosa squamosa (Bruguière)

Balanus squamosa Bruguière, 1789, p. 170.

Tetraclita porosa viridis Darwin, 1854, p. 329.—Kruger, 1911, p. 61, pl. 4, fig. 41b.—Nilsson-Cantell, 1921, p. 364; 1930, p. 17; 1931, p. 115; 1934a, p. 71; 1934b, p. 61, 1938, p. 76.

Tetraclita squamosa squamosa Pilsbry, 1916, p. 251.

Tetraclita squamosa viridis Broch, 1922, p. 337.—Hiro, 1937, p. 66, figs. 13a, 13b; 1939, p. 271.

Locality: Ifaluk Atoll, Caroline Islands; collected by F. M. Bayer, Sept. 20, 1953, on the outer reef of Ella Island (4 specimens, USNM 99342).

Tetraclita pacifica Pilsbry emend.

Plate 3,*a–i*

Tetraclita wireni pacifica Pilsbry, 1928, p. 312, pl. 26, figs. 1–5.

Locality: South Loi Island, Kwajalein Atoll, Marshall Islands; collected by F. S. McNeil, 1951–52 (11 specimens, USNM 96486).

Supplementary diagnosis: This species differs from all other species of *Tetraclita* by a combination of the following characteristics: the small number of tubes in the parietes, the presence of calcareous spines in the parietal tubes, and the inconspicuous adductor ridge of the scutum.

SUPPLEMENTARY DESCRIPTION: Shell conical with small or moderately large orifice; wall finely ribbed in young, rugose and often corroded in adult. Color white or white tinged with Prussian red. Radii narrow, transversely grooved in young, inconspicuous or obliterated in adults. Sheath Prussian red, usually long; inner lamina faintly ribbed internally. Tubes in parietes arranged in a row of large quadrangular tubes, radially elongate, and a varying number of small triangular or round tubes near the outer lamina. In a specimen with a carinorostral diameter of 18 mm. (pl. 3,*a*), the number of large tubes is 11 in the rostrum, 8 in one lateral and 9 in the other, and 6 in the carina; the number of small tubes is 6 in the rostrum, 5 in one lateral and 7 in the other, and 2 in the carina. In specimens with maximum diameters of 21 mm., 26 mm., and 30 mm., some plates have a third series of tubes formed by the bifurcation of the septa of the second series of tubes. In a specimen with a carinorostral diameter of 26 mm., the number of large tubes is 12 in the rostrum, 6 in one lateral and 7 in the other, and 8 in the carina. The number of small tubes in the second series is 9 in the rostrum, 1 in one lateral and 2 in the other, and 5 in the carina. The number of tubes in the third series is 3 in the rostrum, 2 in the carina, and none in either lateral. Large tubes not filled up even at apex of shell; many of tubes with calcareous spines in 1 to 6 rows extending nearly to apex of tubes on the inside of the outer lamina and less frequently scattered on the sides of the septa and the outside of the inner lamina; small tubes occasionally with 1 to 2 rows of spines. Spines straight or curved with pointed, single or double ends (pl. 3,*b*,*c*). The spines, which are hollow, extend from the outer edge of the outer lamina to the inner edge where they project into the cavity of the tube; maximum length of free part of spine, 1.3 mm. Figure 3,*d*, a section through the outer lamina, shows the cavity in the upper spine and the surface of the spine below it. Outer lamina often ridged at base, occasionally ridges extend short way up tube; septa sometimes finely denticulate near outer lamina. The two smallest specimens with carinorostral diameters of 2.5 mm. and 6.0 mm. have a single row of tubes without spines. The next largest specimen, with a carinorostral diameter of 15 mm., has 14 secondary tubes near the outer lamina. Basis calcareous, radially ridged internally near outer edge.

Carinorostral diameter of type, 21.1 mm. Carinorostral diameter of largest specimen from the Marshall Islands, 21 mm., lateral diameter, 30 mm.; height of rostrum, 20 mm., height of carina, 10 mm.

Scutum (pl. 3,*e*) with occludent margin longer than basal. Externally, white with narrow growth ridges, alternate ones forming oblique teeth on occludent margin, faint longitudinal striations, and either a shallow longitudinal furrow or translucent area in middle of

valve. Internally, white with Prussian red at apex and sometimes extending down middle; articular ridge low, slightly reflexed, about half the length of tergal margin; articular furrow narrow; adductor ridge short, very low or represented by mere thickening of the valve; crests for lateral depressor prominent, 4 in number; crests for rostral depressor finer, more numerous.

Tergum (pl. 3,*f*) narrow, beaked. Spur narrow with rounded end, one side united with basiscutal angle and other side sloping gradually to the slightly oblique basal margin. Externally, white with shallow depression running to spur. Internally, articular ridge extremely narrow and low; articular furrow moderately wide; scutal margin slightly inflected; crests for depressor prominent.

Labrum with concave, spinose margin bearing 7 to 10 teeth. Palp concave above and convex below with rounded end; spines on end and upper margin pinnate, decreasing in length but increasing in width proximally. Mandible (pl. 3,*h*) with 4 teeth or sometimes with a rudimentary fifth tooth close to the spinate inferior angle; second and third teeth double; the smaller of each double tooth and the fourth tooth with either serrate edge or thickened edge if projections have been worn down. Lower margin of mandible spinose; upper margin with small tuft of spines. First maxilla (pl. 3,*g*) with small notch filled with small spines below upper large pair, about 7 pairs of medium-sized spines below notch, followed by small spines on lower fourth of valve; upper and lower margins spinose. Second maxilla (pl. 3,*i*) with slight notch, without spines; spines shorter above and below notch than on rest of margin.

Cirrus I with anterior ramus nearly twice as long as posterior, long spines and a few short spines on distal sutures finely pinnate on ends; pedicel with plumose spines. Cirrus II with subequal rami, spination like cirrus I. Cirrus III with very unequal rami, posterior about a third longer than anterior ramus; spines on upper segments pinnate; spines on lower segments slender and pinnate or thicker and serrate; pedicel with plumose spines on anterior borders of both segments and a tuft of plumose spines on the posterior distal angle of the lower segment. Posterior cirri with 3 pairs of spines, some pinnate, a few fine spines on the anterior border of each segment, and a tuft of short spines on the posterior distal sutures. Penis with a few spines encircling the orifice and scattered over the segments.

Number of segments in the cirri

Diameter	I	II	III	IV	V	VI
25 mm.	18, 9	10, 9	19, 24	20, 19	21, 22	23, 22
26 mm.	16, 8	9, 9	12, 21	–	–	24, 23

Remarks: Pilsbry (1928, p. 313) states that the wall of *Tetraclita wireni pacifica* has "a single series of square or squarish tubes, in most of them some laminae and often slender spines projecting from the outer layer of the wall"; and yet his figure of the type specimen (pl. 26, fig. 1) clearly shows several small secondary tubes near the outer lamina. The specimens from the Marshall Islands also show one or two series of secondary tubes. Therefore, Pilsbry's subspecies cannot be a subspecies of *Tetraclita* (*Tesseropora*) *wireni*, which has a single row of tubes, and it is proposed to raise it to specific rank in the subgenus, *Tetraclita*, in which the wall has several rows of tubes.

Tetraclita pacifica may be considered the connecting link between these two subgenera, showing the first step in the formation of a multilayer wall; in other species of the subgenus *Tetraclita*, this stage occurs in very young individuals. The structure of the wall, with the exception of the development of secondary tubes, is very similar to that of *T. rosea* and *T. wireni*, the two species in the subgenus *Tesseropora*. The tubes in the first row are similar in size and shape to those in the single row in *T. rosea* and *T. wireni*, and calcareous spines and laminae instead of laminae alone have been developed to strengthen the outer wall.

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